Michigan Department of Community Health

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Risk Factors Associated with Early Hearing Diagnostic Evaluation among Michigan Infants: MI EHDI and MBDR Data, 2004-2006

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Introduction

The CDC and other organizations set the Early Hearing Detection and Intervention (EHDI) goal that all infants failing the final hearing screen should have a diagnostic evaluation by three months of age. However, in the US, only 66% of infants failing the final screen are diagnosed by three months, and in MI, only 54% of infants born in 2008 were diagnosed by three months of age (figure 1).[1,2] Infants with hearing loss should be diagnosed in a timely manner so that they may benefit from early intervention services and maximize the critical period of language development in early childhood.[3]

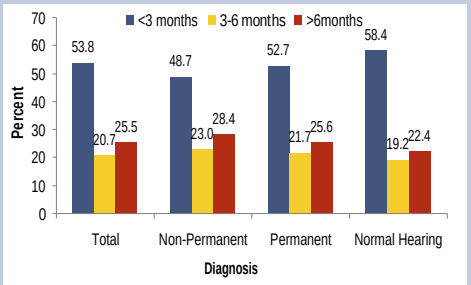

Figure 1: Age at diagnostic evaluation by type of diagnosis for infants who failed their last hearing screen: Michigan EHDI, 2008.[2]

Purpose

Explore potential factors that may affect reaching the goal of all infants being diagnosed with hearing loss by 3 months of age in order to identify efficient strategies for improvement.

Methods

Source of Data and Study Design: This is a cross sectional study linking the MI EHDI Program data to the Michigan Birth Defects Registry (MBDR) data via live birth records as an intermediate file, using the birth certificate number as a common, unique identifier.

Source Population: Infants with an audiologic evaluation, born from 2004-2006, identified from the MBDR-EHDI linked file.

Outcome and Variables: The outcome was having an audiologic evaluation by 3 months of age, as reported to the EHDI program. The following factors were included in adjusted models: total number of co-morbid conditions, hearing loss diagnosis, and maternal race, age, and education.

Statistical Analysis: Logistic regression was used to estimate the crude and adjusted associations (odds ratios and 95% confidence intervals) between exposure variables and the outcome. SAS v. 9.1 was used for statistical analysis.

Figure 2: Percentage of total infants with diagnosis by 3 months of age, by selected factors: MBDR-EHDI data, 2004-2006.[4]

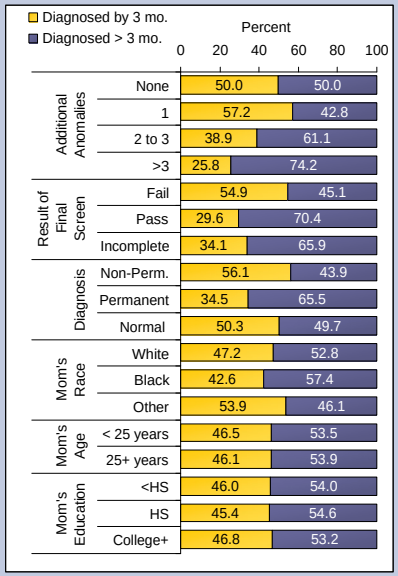

Table 1: Estimated crude and adjusted effects (OR and 95% CI) of selected factors on diagnostic evaluations by 3 months of age: MBDR-EHDI data, 2004-2006.[4]

Risk Factors	Number Infants	Crude OR	Adjusted* OR	Adjusted* 95% CI
Total Additional Anomalies				
None	448	1	1	
One	285	1.3	1.2	(0.83, 1.7)
Two to Three	203	**0.64**	**0.58**	**(0.39, 0.87)**
More than Three	155	**0.35**	**0.35**	**(0.22, 0.55)**
Result of Final Screen				
Fail	720	1	1	
Pass	304	**0.35**	**0.31**	**(0.22, 0.43)**
Incomplete	91	**0.43**	**0.38**	**(0.22, 0.68)**
Diagnosis				
Non-Permanent	264	1	1	
Permanent	414	**0.41**	**0.42**	**(0.30, 0.59)**
Normal Hearing	290	0.80	0.81	(0.55, 1.2)
Maternal Race				
White	818	1	1	
Black	256	0.83	**0.70**	**(0.49, 0.98)**
Other	39	1.3	1.32	(0.64, 2.7)
Maternal Age				
< 25 years old	415	1	1	
25+ years old	700	0.99	0.96	(0.70, 1.3)
Maternal Education				
<High School	235	1	1	
High School	377	0.98	1.0	(0.71, 1.5)
College or More	479	1.0	1.1	(0.72, 1.6)

*Adjusted for all factors in the table.

Results

•A total of 1,115 infants with an audiologic evaluation were identified from the linked MBDR-EHDI file and of those, 46% (n=513) had an evaluation by 3 months of age.

•Diagnosis rates by 3 months of age were *lowest* among those who (Figure 2):
- •Had more than 3 additional anomalies
- •Passed the final hearing screen
- •Were diagnosed with permanent hearing loss
- •Were black

•Significant findings from adjusted analyses (Table 1):
- •Those who had 2 to 3 co-morbid anomalies were less likely (OR=0.58, 95% CI: 0.39, 0.87) and those with >3 co-morbid anomalies were less likely (OR=0.35, 95% CI: 0.22, 0.55) to be diagnosed by 3 months of age than those with no additional anomalies.
- •Those who had passed or had an incomplete final hearing screen were less likely (OR=0.31, 95% CI: 0.22, 0.43 and OR=0.38, 95% CI: 0.22, 0.68, respectively) to have a timely diagnosis than those who failed the final screen.
- •Those with permanent hearing loss were less likely (OR=0.42, 95% CI: 0.30, 0.59) to be diagnosed by 3 months of age than those with non-permanent hearing loss, in both crude and adjusted analyses.
- •Those who were black were less likely (OR=0.70, 95% CI: 0.49, 0.98) to be diagnosed by 3 months of age than those who were white, in adjusted analysis.

•Additional Anomalies (Table 2):
- •In adjusted analysis, those with alimentary canal or digestive system defects were less likely (OR=0.35, 95% CI: 0.17, 0.72) to have a diagnosis by 3 months of age than those without the defect.
- •In adjusted analysis, those with musculoskeletal defects were more likely (OR=1.7, 95% CI: 1.1, 2.7) to have a diagnosis by 3 months of age than those without the defect.

Table 2: Estimated crude and adjusted effects (OR and 95% CI) of birth defects on diagnostic evaluations by 3 months of age: MBDR-EHDI data, 2004-2006.[4]

Additional Anomaly	Number of Infants	Crude OR	Adjusted* OR	Adjusted* 95% CI
CNS	85	**0.61**	1.2	(0.62, 2.2)
Eye	46	0.89	1.4	(0.64, 3.0)
Ear, Face, Neck	71	1.1	1.3	(0.70, 2.4)
Heart and Circulatory	255	**0.54**	0.66	(0.43, 1.0)
Respiratory	84	**0.44**	0.98	(0.53, 1.8)
Cleft Lip/Palate	47	0.85	0.88	(0.38, 2.0)
Alimentary / Digestive	90	**0.24**	**0.35**	**(0.17, 0.72)**
Genital and Urinary	96	1.0	1.5	(0.86, 2.7)
Musculoskeletal	163	0.98	**1.7**	**(1.1, 2.7)**
Integument	36	0.64	0.65	(0.28, 1.5)
Chromosomal	83	0.79	1.1	(0.62, 1.9)
Other and Unspecified	70	**0.44**	0.73	(0.37, 1.5)

For each category, the reference is those who did not have that specific diagnosis, but have any other diagnosis or diagnoses.

*Adjusted for total number of anomalies, result of final screen, diagnosis, maternal race, age, and education.

Discussion

•More knowledge of the factors contributing to timely diagnosis of hearing loss is necessary to develop strategies targeted to those who are not fully benefiting from early intervention services.

•Additional analyses for infants with multiple conditions should be explored in detail to assess explanations for early or late audiologic diagnoses.

•Extra attention and care must be given to infants with multiple conditions so that they have timely diagnoses and referral to appropriate services. Early enrollment in intervention services for hearing loss can help improve childhood and language development.[3]

•Children with hearing loss and other co-morbid conditions, along with their families, may benefit from a clinical genetic evaluation to identify potential genetic risk factors.

•Screening for hearing loss should not stop at infancy. School-age children should continue to have hearing screens to identify late-onset hearing loss so that they may receive appropriate services early.[5]

Limitations:
- •Birth defects diagnoses reporting is per the MBDR and the severity of each case is not known.
- •The categories of diagnoses are not exclusive – children with more than one defect may be in more than one category. This issue was minimized by additionally analyzing single and multiple anomalies.
- •The sample size could be increased by analyzing additional years of data to gain more insight into the population.

References

1. National EHDI Goals. Centers of Disease Control and Prevention. Found on 2 August 2010 at <http://www.cdc.gov/ncbddd/ehdi/nationalgoals.htm>
2. Michigan Early Hearing Detection and Intervention (EHDI) Data, 2008.
3. Yoshinaga-Itano C, Sedey A. Early Speech development in children who are deaf or heard of hearing: Interrelationships with language and hearing. Volta Review. 1999;103: 570-575.
4. Linked Michigan Birth Defects Registry (MBDR) and Michigan Early Hearing Detection and Intervention (EHDI) Data, 2004-2006.
5. Hearing Screening. American Speech-Language-Hearing Association (ASHA). Retrieved on 12 August 2010 from <http://www.asha.org/public/hearing/testing/>

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